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ABSTRACT

Evidence suggests that the neurological substrate of emotional behavior is lateralized by brain hemisphere early in life. A study examined the emotional expressions of preterm infants, some of whom had unilateral periventrical echodensities (PVE), as a model for addressing this issue. The study population of 25 preterm infants was videotaped at 3 months and again at 12 months corrected age during 3 situations designed to illicit joy, surprise, or anger. The group included 9 children with right or left hemisphere PVE, most of whom also had bilateral intraventricular hemorrhage (IVH), 5 with IVH only, and 11 with no ultrasonographic abnormalities. The infants' facial expressions were coded, and positions of the brows, eyes, and mouth were noted every second for 10 seconds following stimulus onset. At each age a number of comparisons were made to test whether one cerebral hemisphere dominated the control of all the emotional expressions or whether dominance was a function of the valence of the expression. Comparisons also focused on the impact of IVH, additional medical complications, and mothers' affect. There were few significant differences in any of the comparisons at 3 months, though data suggested support for the hypothesis that the right brain hemisphere predominates in control of anger and the left hemisphere controls joy expressions. At 12 months, there were many more significant differences than at 3 months, but data did not support theories of lateralized control of expressivity. (Author/AC)

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CONTROL OF EMOTIONAL EXPRESSIVITY IN THE FIRST YEAR OF LIFE

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ABSTRACT

Evidence suggests that the neurological substrate of emotional behavior is lateralized early in life. One hypothesis suggests that the right cerebral hemisphere is dominant in the control of all emotional processes, while the other proposes right hemisphere control of negative emotions, and left hemisphere dominance of positive affective states. This study examined the emotional expressions of preterm infants, some of whom had unilateral periventricular echodensities (PVE), as a model for addressing this issue.

Twenty-five preterm infants were seen at 3 months and again at 12 months corrected age. Nine children had right or left hemisphere PVE. Most of these subjects also had bilateral intraventricular hemorrhage (IVH). Five subjects had IVH only. A third group of 11 had no ultrasonographic abnormalities and were matched to the PVE group by birthweight, sex, birth order and minority status.

The infants were videotaped during 3 situations designed to elicit joy, surprise or anger. Their facial expressions were coded using the Maximally Discriminative Facial Movement Coding System (MAX; Izard, 1979). Positions of the brows, eyes and mouth were noted every second for 10 seconds following stimulus onset. Dependent variables were: latency to first change of expression in each situation; latency to target expression; intensity of target expression; percentage of subjects exhibiting the target expression; and latency to the first change in expression summed across all 3 situations.

At each age a number of comparisons were made designed to test whether one cerebral hemisphere dominated the control of all of the emotional expressions or dominance was a function of the valence of the expression. In addition, comparisons indicated whether IVH alone had an equivalent impact on emotional expressivity. Two additional comparisons were made. Subjects with a large number of other neonatal medical complications were compared to those who were less sick. This was designed to determine whether more diffuse CNS insults had an impact on emotional expression. Secondly, the expressivity of subjects whose mothers exhibited much positive affect in a play situation were compared to those whose mothers were less positive. This comparison addressed the issue of environmental determination of emotional expressivity. Tests of significance were by Mann-Whitney U and Fischer Exact.

There were few significant differences in any of the comparisons at 3 months, however the data suggested support for the hypothesis that the right

hemisphere predominates in control of anger and the left hemisphere controls joy expressions. At 12 months there were many more significant differences, however no support for either theory of lateralized control of expressivity. At 12 months, it appeared that more diffuse insults - IVH alone, or many early medical complications - was as highly related to depressed emotional expressivity as right or left-sided PVE. In addition, children whose mothers displayed more positive affect during play were quicker to show joy expressions. These results suggest a possible developmental progression in influences on emotional expressivity from subcortical to cognitive and social.

OBJECTIVES

1. To determine whether there is support for the hypothesis that emotional expressions are predominantly controlled by one cerebral hemisphere. There are two competing propositions: a) the right hemisphere controls all emotional processes; b) the hemisphere which predominates is determined by the valence of the emotion - right controls negative and left positive affective processes.

2. To determine whether complications of preterm birth which affect the perfusion and oxygenation of the brain have an impact on emotional expressivity.

3. To determine whether the social environment has an impact on emotional expressivity.

4. To determine whether there are changes in the impact of early medical complications and socialization on emotional expressivity over the first year of life.

METHODS

SUBJECTS:

25 Preterm Infants

Mean Birth Weight = 1241 $\pm$359 grams

Mean Gestational Age = 29.7 $\pm$2.4 weeks

Mean Hollingshead 4-Factor SES = 42.9 $\pm$11.7

40% Male

52% Firstborn

100% Right-Handed Parents

All subjects were studied by real-time ultrasonography at 4 hours, 24 hours, 7 days and weekly thereafter if deemed necessary. The senior attending radiologist determined that:

5 developed periventricular echodensities (PVE) in the right periventricular region

4 developed PVE on the left

5 developed bilateral IVH but not PVE

11 developed neither PVE nor IVH

PROCEDURE:

At 3 and 12 months corrected age emotional expressions were elicited by a standardized set of procedures.

Procedure	Target Expression	Valence
Tickling, talking, smiling	JOY	positive
Jack-In-The-Box	SURPRISE	neutral
Arm Restraint	ANGER	negative

Videotaped expressions were coded using the Maximally Discriminative Facial Movement Coding System (MAX). Expressions determined by positions of eyes, brows and mouth, were coded second by second for 10 seconds following stimulus onset. At the beginning of each episode subjects had neutral or interest expressions.

Dependent Variables: At each age -

In each situation:
Latency to first expression change
Latency to target expression
Intensity of facial expression
Percentage of subjects showing target expression

Over all 3 Situations:
Latency to first expression change

RESULTS

Comparisons:

To determine if damage of one cerebral hemisphere affects emotional expressivity -

- right PVE vs left PVE
- right PVE vs -PVE/IVH
- left PVE vs -PVE/IVH

To determine if early hypoxic/ischemic or hemorrhagic brain insults affect emotional expressivity the number of medical complications of prematurity other than IVH* suffered by each subject was derived and the median was used to define a high compiications group and a low complications group -

- $\geq$6 vs <6 medical complications
- IVH vs -PVE/IVH

To determine if the social environment affects emotional expressivity the amount of positive affect displayed by mothers during a free play session was coded and the median determined -

- subjects with more positive mothers vs less positive mothers

Mann-Whitney U was used to compare group means and the Fischer Exact Test to compare percentages.

*The Medical Complications Score was the sum of the following conditions suffered by the subject: RDS, mechanical ventilation, apnea for more than two weeks, gestational age < 30 weeks, hyperbilirubinemia, metabolic disorders, meningitis, sepsis, hypoxemia, shock, low hematocrit on admission, acidosis, bronchopulmonary dysplasia.

3 Months

No comparisons showed statistically significant differences. However there were two trends:

Ss with left PVE were slower to show a change in expression in the joy situation than Ss with right PVE (5.0 vs 1.2 seconds, $p<.1$). They also took twice as long to exhibit a joy expression (7.0 vs 3.6 seconds), and joy expressions were considerably less intense (.75 vs 1.6).

Ss with right PVE showed more intense joy expressions than Ss with no sonographic abnormality (1.6 vs .64, $p<.1$). They were also quicker to show joy (3.6 vs 6.6 seconds).

12 Months

There were more statistically significant findings at 12 months. These are displayed below.

- Ss with right side PVE took longer to change expression in the surprise situation than Ss with no abnormality.
- Ss with many medical complications had longer latencies to an expression change in the anger situation. They also tended to show a longer latency to change expression in the surprise situation ($p<.01$).

- Ss with left PVE took longer to show anger than Ss with no abnormality, and there was a trend for them to show longer latencies in this situation than Ss with right PVE ($p<.1$).
- Ss with more medical complications took longer to show anger than Ss who were less sick.
- There was a trend for Ss with less positive mothers to take longer showing joy ($p<.1$).

- Ss with right PVE showed less intense expressions of joy than Ss with no abnormality.
- Ss with left PVE showed less intense expressions of anger than Ss with no abnormality.
- Ss with right PVE tended to show more intense anger than those with left PVE ($p<.1$).
- Ss with IVH tended to show less intense joy expressions than Ss with no abnormality ($p<.1$).
- Ss with many medical complications showed less intense anger responses than Ss with no abnormality, and tended to show less intense joy ($p<.1$).

- There were no significant group differences, but fewer Ss showed expressions of surprise and anger than of joy.

- Ss with left PVE took longer to show emotional reactions than Ss with no abnormality.
- Ss with IVH tended to be slower to show emotional reactions than Ss with no abnormality ($p<.1$).
- Ss with more medical complications took longer to show emotional reactions than Ss with fewer medical complications.

CONCLUSIONS

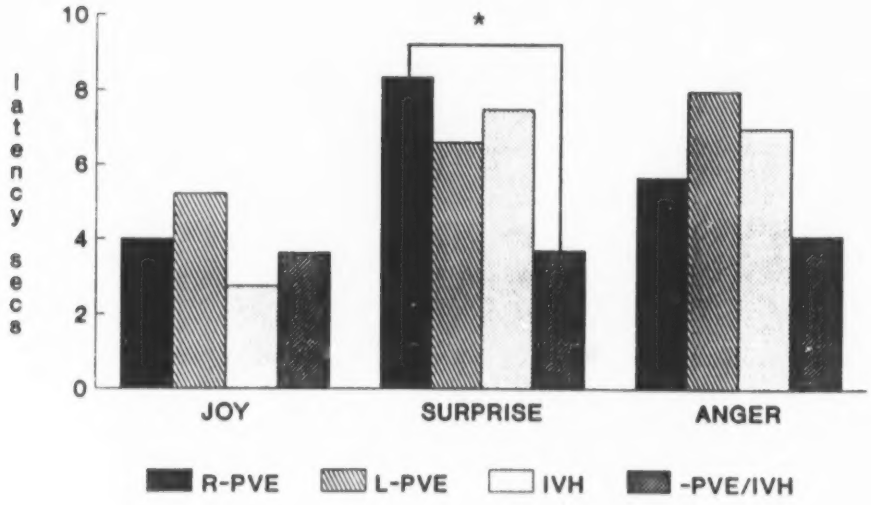
1. This study provides little support for either theory of lateralized control of emotional expressions. However the few statistical trends at 3 months were consistent with the hypothesis that the left cerebral hemisphere predominates in the control of positive emotional expressions, while the right controls negative expressions. At 12 months all of the statistically significant lesion group differences and trends were counter to either the right dominant control or the valence specific hemispheric control hypotheses.

2. There was support for the proposition that more diffuse CNS insults associated with complications of preterm birth, including IVH, dampen emotional expressivity in the first year of life.

3. This study suggests that children of mothers who show less positive affect are slower to exhibit expressions of joy.

4. There did appear to be a change in influences on the child's expressivity over the first year. At 3 months of age the infant is less socialized. The results suggest that at this age, when one cerebral hemisphere is damaged, emotional expressions presumed to be controlled by the contralateral hemisphere become less inhibited and thus appear more quickly and intensely. At 12 months, the strongest suggestion from this study is that relatively diffuse early brain insults may produce deficits in emotional responses, particularly anger. In addition, there appears to be some support for the socialization of emotional expressivity since at 12 months the data suggest that a mother's expressivity affects that of her child, which was not the case at 3 months of age.

Latency to First Expression
By Lesion Group



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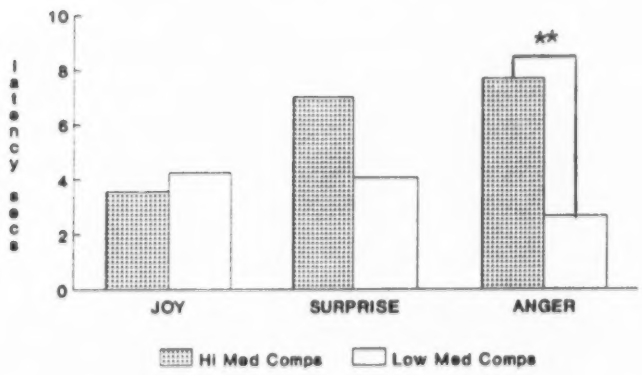
Latency to First Expression
By Medical Complications



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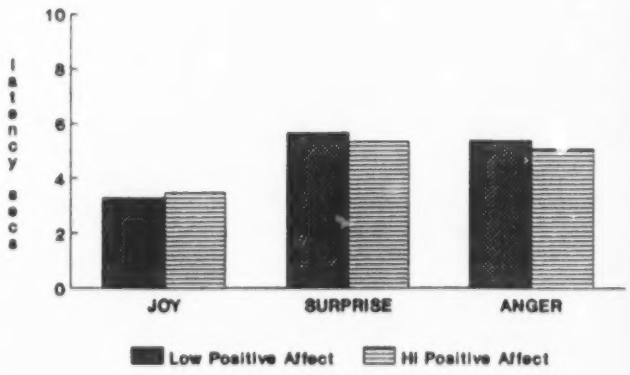
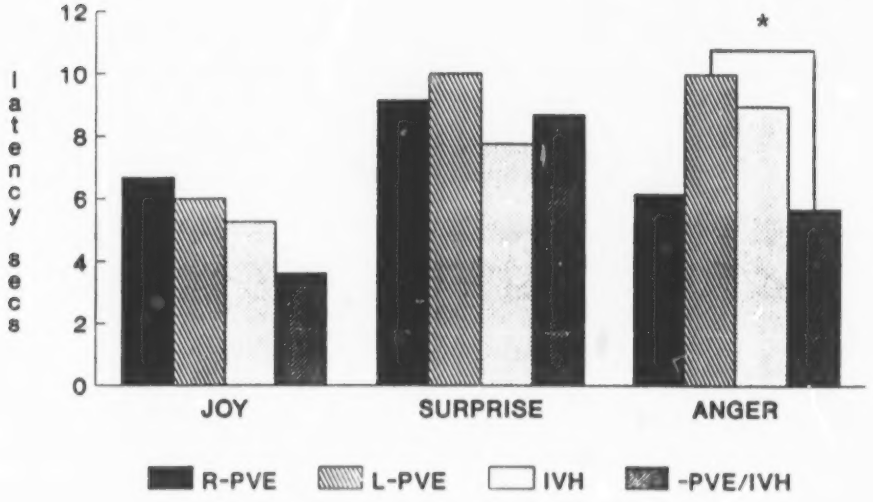
Latency to First Expression
By Maternal Affect



Latency to Target Expression
By Lesion Group



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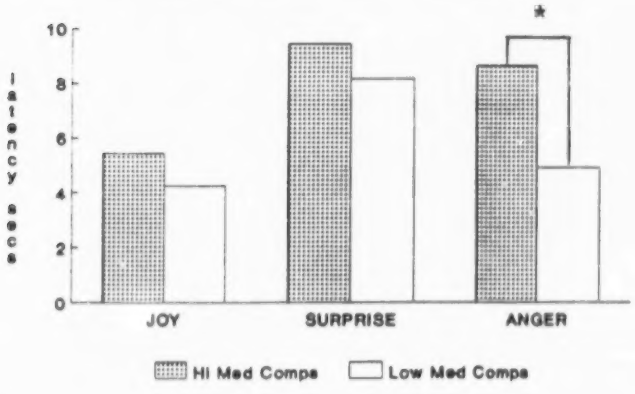

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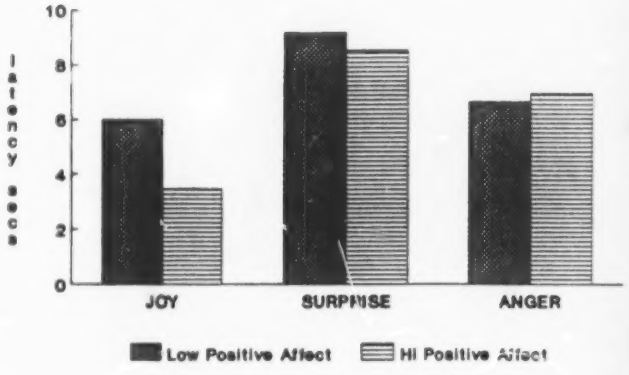
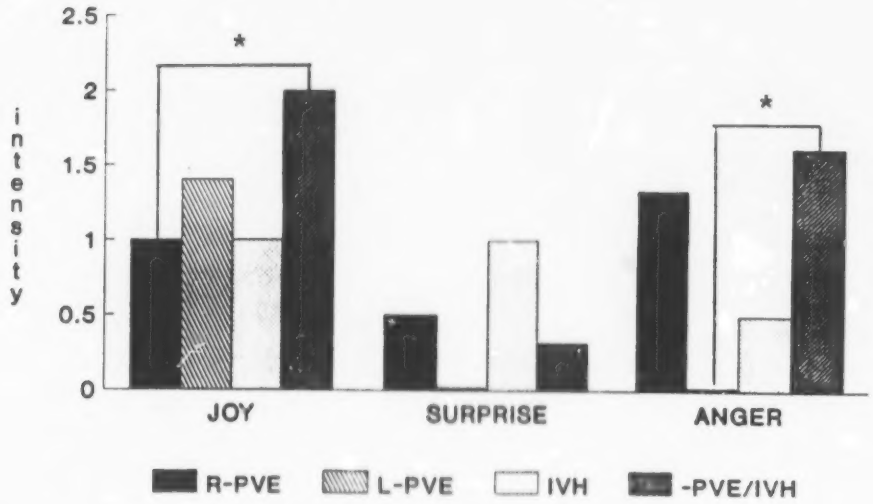


Intensity of Target Expression
By Lesion Group



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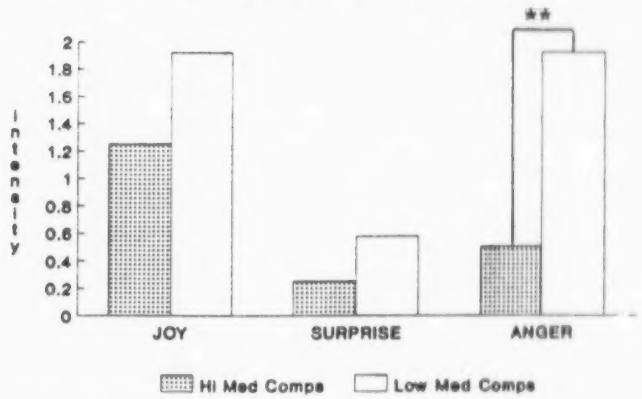
By Medical Complications



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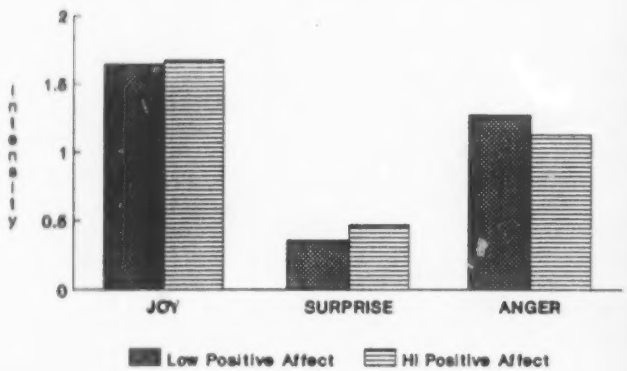
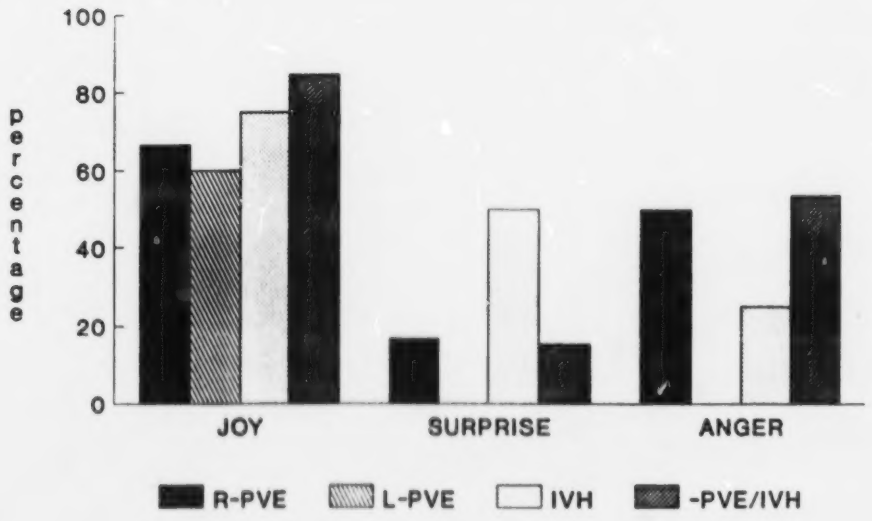
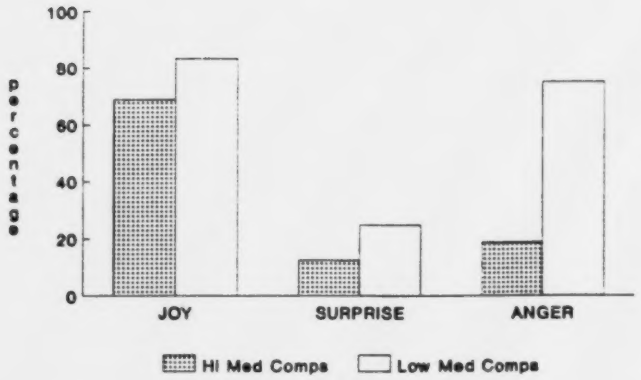
Intensity of Target Expression
By Maternal Affect



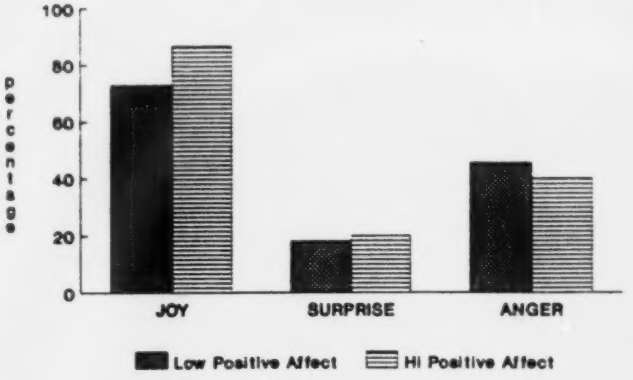
Percentage Showing Target Expression By Lesion Group



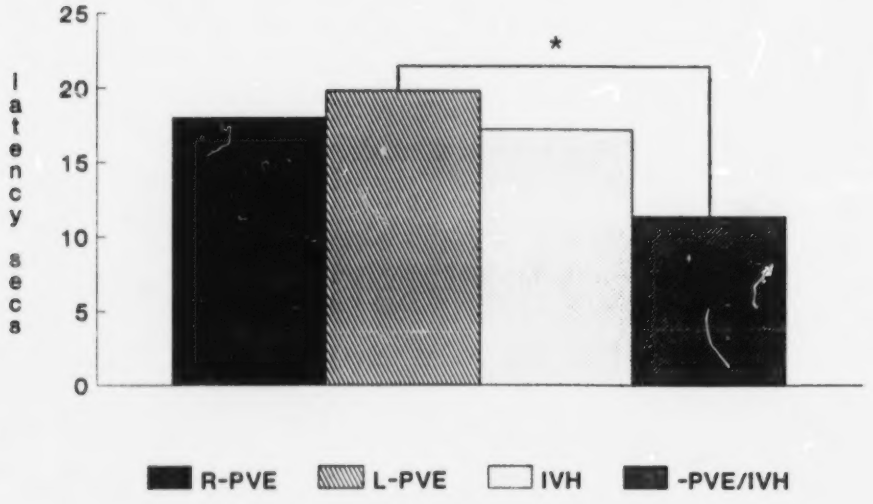
Percentage Showing Target Expression By Medical Complications



Percentage Showing Target Expression By Maternal Affect

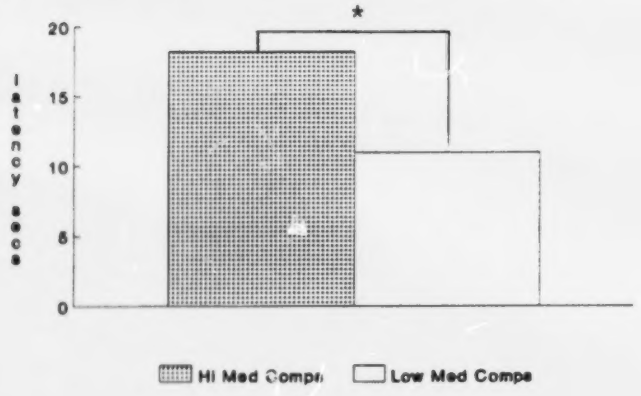


Latency to First Expression Across Situations by Lesion Group



*p<.05

Total Latency to First Expression By Medical Complications



*p<.08

Total Latency to First Expression By Maternal Affect